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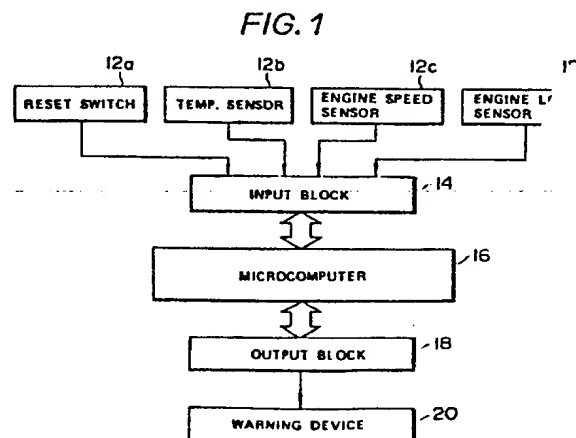
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### (54) Oil degradation warning system.

(57) Herein disclosed is an oil degradation warning system which comprises several sensors (12b, 12c, 12d) for sensing parameters which are closely related to degradation factors of the engine oil, a microcomputer (16) which processes the detected parameters to compute oil degradation coefficients of them in each factor, integrates the oil degradation coefficients in each factor with passage of time, and issues an instruction signal when at least one of the integrated values of the oil degradation coefficients exceeds a corresponding reference value, and a warning device (20) which gives a warning when the instruction signal is applied thereto.



## OIL DEGRADATION WARNING SYSTEM

BACKGROUND OF THE INVENTION1. Field of the Invention

5 The present invention relates in general to a warning system of a motor vehicle, and more particularly to a so-called "oil degradation warning system" which automatically gives a visual or audible warning when the engine oil has been degraded to a certain unusable degree.

2. Description of the Prior Art

10 As is known, engine oil functions not only to lubricate movable metal parts, such as pistons or the like, but also to remove heat from heated parts of the engine. However, long use of the engine oil degrades the nature thereof and thus prevents the oil from exhibiting satisfied lubrication and heat removing functions.

15 In view of the above, several kinds of oil degradation warning systems have been hitherto proposed, which, by using intake vacuum, oil temperature, and engine speed and/or moved distance as parameters for estimating the degradation degree of the engine oil, calculate the time (viz., the oil change time) when the oil should be changed with new or fresh one and give a visual or audible warning at that time. Some of them are disclosed in Japanese Patent Application First Provisional Publications Nos. 59-27260 and 59-43299.

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30 However, in these hitherto proposed systems, the parameters as mentioned hereinabove are "totally" treated for calculating the oil change time, so that it inevitably occurs that the oil change time is

calculated with noticeable error. Thus, in such systems, it sometimes occurs that the warning is given considerably before or after the time when the oil change is practically necessary.

5     SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an oil degradation warning system which can precisely calculate the oil exchange time and gives a warning at just the time when the oil exchange is practically necessary.

10     According to the present invention, there is provided an oil degradation warning system which comprises first means for detecting a plurality of parameters which are closely related to degradation factors of the engine oil; second means for  
15     processing the parameters to provide oil degradation coefficients of the parameters in each factor and integrating the oil degradation coefficients in each factor with passage of time; third means for issuing  
20     an instruction signal when at least one of the integrated values of the oil degradation coefficients exceeds a corresponding reference value; and fourth means for giving a warning when the instruction signal is applied thereto.

25     BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawings, in which:

30     Fig. 1 is a block diagram of an electric circuit employed in an oil degradation warning system of the present invention;

Figs. 2 and 3 are flowcharts for carrying out a

program set in the oil degradation warning system of the present invention;

5 Figs. 4A, 4B and 4C are graphs which show respectively the viscosity dependent oil degradation coefficients of oil temperature, engine speed and engine load;

10 Figs. 5A, 5B and 5C are graphs which show respectively the basicity dependent oil degradation coefficients of oil temperature, engine speed and engine load; and

Figs. 6A, 6B and 6C are graphs which show respectively the infusible matter dependent oil degradation coefficients of oil temperature, engine speed and engine load;

15 DETAILED DESCRIPTION OF THE INVENTION

As will become apparent as the description proceeds, in accordance with the present invention, the degree of oil degradation is estimated from three major factors, which are the viscosity of oil, the basicity of oil and the amount of infusible matters in oil. Because of difficulty in directly measuring these factors in consequence manner, the present invention uses the oil temperature, the engine speed and the engine load as parameters for estimating these factors, that is, for estimating the degree of oil degradation.

Referring to Fig. 1, there is shown a block diagram of the oil degradation warning system 10 according to the present invention. As is seen from the drawing, the system 10 comprises generally a sensor block 12, an input block 14, a microcomputer block 16, an output block 18 and a warning block 20.

The sensor block 12 includes a reset switch 12a,

an oil temperature sensor 12b, an engine speed sensor 12c and an engine load sensor 12d. The reset switch 12a is constructed to issue a reset signal when oil change is practically carried out in the associated engine. The oil temperature sensor 12b is a sensor for detecting the temperature of the engine oil contained in the cylinder block of the engine. The engine speed sensor 12c is a sensor for detecting the rotation speed of the engine. A known crank-angle sensor may be used therefor. The engine load sensor 12d is a sensor for detecting a load applied to the engine, which is, for example, an intake vacuum sensor mounted to the intake part of the engine. If desired, the engine load may be determined by computing signals issued from an air flow rate sensor (not shown) and a next-mentioned engine speed sensor.

As will become apparent hereinafter, the oil temperature sensor 12b, the engine speed sensor 12c and the engine load sensor 12d detect three parameters (viz., oil temperature, engine speed and engine load) which are closely related to the degradation factors of the engine oil.

Receiving the information signals from the oil temperature sensor 12b, the engine speed sensor 12c and the engine load sensor 12d through the input block 14, the microcomputer 16 calculates the oil degradation coefficients of the parameters in each factor and adds and integrates the calculated degradation coefficients in each factor with passage of time and if at least one of the integrated values exceeds a corresponding reference value which has been predetermined, the microcomputer 16 issues an output signal to the output block 18. These

operations are carried out in accordance with a given program which is depicted by the flowcharts of Figs. 2 and 3. The program is set in a ROM in the microcomputer 16. The computer 16 includes a non-volatile RAM which can memorize the current data even when an ignition switch of the engine is turned off.

The warning block 20 comprises an indicator which issues a visual or audible warning when the microcomputer 16 issues an output signal to the output block 18.

In the following, the given program will be described with reference to the flowcharts shown in Figs. 2 and 3.

When an ignition switch (not shown) of the associated engine is turned on, the program starts.

At STEP 1, the content of the memory is initialized, and the operation flow goes to STEP 2 where a judgement as to whether or not a reset signal from the reset switch 12a is inputted thereto is carried out. That is, when, due to completion of oil change, the reset switch 12a is actuated, a reset signal is issued from the reset switch 12a and applied to the microcomputer 16 through the input block 14. With this, the operation flow goes to STEP 3 where the integrated values of  $S_1$ ,  $S_2$  and  $S_3$  are each reset to zero (viz., 0).

It is to be noted that  $S_1$  is the integrated value of oil degradation coefficient dependent on viscosity of oil, and  $S_2$  and  $S_3$  are those dependent on basicity of oil and amount of infusible matters in oil, respectively. This will become clear hereinafter.

Once the reset signal is applied to the circuit, subsequent operation flow goes to STEP 4 without passing through STEP 3. This continues until another oil change is practically carried out.

5        At STEP 4, a judgement as to whether or not a predetermined time has passed is carried out. This is done by a time counter included in the microcomputer 16. When the predetermined time has passed, the operation flow goes to STEP 5 where the data supplied from the oil temperature sensor 12b, 10        the engine speed sensor 12c and the engine load sensor 12d are read. And, at this STEP, with reference to the correlations depicted by the graphs of Figs. 4A to 6C, the viscosity dependent oil degradation coefficients (viz.,  $A_1$ ,  $B_1$  and  $C_1$ ) of oil, 15        temperature, engine speed and engine load, the basicity dependent oil degradation coefficients (viz.,  $A_2$ ,  $B_2$  and  $C_2$ ) of oil temperature, engine speed and engine load, and infusible matter dependent oil degradation coefficients (viz.,  $A_3$ ,  $B_3$  and  $C_3$ ) of oil, 20        temperature, engine speed and engine load are calculated from the data issued from the sensors.

Now, the gradation of engine oil will be outlined from a viewpoint of viscosity, basicity and amount of infusible matters in the oil. 25

As is known, using the engine oil at high temperature hastens oxidation of the oil and thus increases the viscosity of the same. Further, adding any combusted product, such as blowby gas, into the oil increases the viscosity of the same. On the 30        contrary, adding fuel (gasoline) into the oil reduces the viscosity of the oil. Furthermore, when the oil is stirred vigorously, the viscosity of the oil

lowers because any viscosity increasing polymer contain d therein is mechanically broken. This phenomenon becomes much severe when a so-called "multigrade oil" is used. As is known, too much lowering and too much increasing of the viscosity of the engine oil induce poor lubrication of the moving metal parts, which sometimes brings about the undesirable piston seizure of the engine. Considering these phenomena, the graphs of Figs. 4A, 4B and 4C are provided.

Figs. 4A, 4B and 4C show the viscosity dependent oil degradation coefficients of oil temperature, engine speed and engine load. As is seen from Fig. 4A, when the oil temperature is high, the viscosity dependent oil degradation coefficient shows a high degree. This is because of increased oxidation of the oil per se. While, when the oil temperature is low, the coefficient is low. As is seen from Fig. 4B, with increase in engine speed, the viscosity dependent oil degradation coefficient lowers. This is because of the mechanical breakage of the viscosity increasing polymer contained in the oil. As is seen from Fig. 4C, the viscosity dependent oil degradation coefficient increases with increase in engine load. This is because of increase of blowby gas with increase in the engine load. (In case of Diesel engine, the amount of smoke increases as the engine load increases).

In the next, the oil basicity dependent oil degradation coefficients will be described. The basicity represents the amount of remaining alkaline additives which neutralize acid matters such as combusted products of sulfur or the like. As is

known, poor basicity causes corrosion of metal parts.

Figs. 5A, 5B and 5C show the basicity dependent oil degradation coefficients of oil temperature, engine speed and engine load. As is seen from Fig. 5A, the basicity dependent oil degradation coefficient increases when the oil temperature is relatively low and relatively high. This is because, at low temperature, the oil tends to produce a sludge of metal oxide which reduces the basicity of the oil, while, at high temperature, the oxidation of the oil per se becomes active causing lowering of basicity. The basicity dependent oil degradation coefficients of the engine speed and the engine load have such correlations as depicted by Figs. 5B and 5C respectively.

In the next, infusible matters in the oil will be described. Oxidation products, smoke and metal powders are the infusible matters. The infusible matter dependent oil degradation coefficients of the oil temperature, engine speed and engine load are depicted by Figs. 6A, 6B and 6C, respectively. As is seen from Fig. 6A, the infusible matter dependent oil degradation coefficient of oil temperature increases when the oil temperature is relatively low and relatively high. This is because, at low temperature, metal abrasion phenomenon becomes active, while, at high temperature, oxidation of the oil per se becomes active, both of which cause increase of the amount of the infusible matters in the oil. Regarding to the engine speed, the infusible matter dependent oil degradation coefficient has a nature as shown in Fig. 6B. That is, when the engine speed increases, the amount of

blowby gas increases thereby increasing the amount of the infusible matters in the oil. As is seen from Fig. 6C, the infusible matter dependent oil degradation coefficient of the engine load increases with increase of the same. This is because, at high load of the engine, the amount of blowby gas (or smoke in Diesel engine) increases.

It is to be noted that the correlations shown by the graphs of Figs. 4A to 6C are all memorized in the ROM of the microcomputer 16.

Returning back to Fig. 2, at STEP 6, the viscosity dependent oil degradation coefficients (viz.,  $A_1$ ,  $B_1$  and  $C_1$ ), the basicity dependent oil degradation coefficients (viz.,  $A_2$ ,  $B_2$  and  $C_2$ ) and the infusible matter dependent oil degradation coefficients (viz.,  $A_3$ ,  $B_3$  and  $C_3$ ) are each added, and the added values are added to previously integrated values  $S_1$ ,  $S_2$  and  $S_3$  to provide up-to-date integrated values  $S_1$ ,  $S_2$  and  $S_3$ . Then, the operation flow goes to STEP 7 the detail of which is depicted by Fig. 3 which will be described hereinnext.

As is shown in Fig. 3, at STEP 11, a judgement as to whether or not the up-to-date integrated value  $S_1$  is greater than or equal to a predetermined reference value  $T_1$  is carried out. If YES, the operation flow goes to STEP 12 and a visual or audible warning is produced giving notice of necessity of oil change. If NO at STEP 11, the operation flow goes to STEP 13 where a judgement as to whether or not the up-to-date integrated value  $S_2$  is greater than or equal to a predetermined reference value  $T_2$  is carried out. If YES, the operation flow goes to STEP 12 and thus a warning is issued from the

5 warning block 20. If NO at STEP 13, the operation  
flow goes to STEP 14 where a judgement as to whether  
or not the up-to-date integrated value  $S_3$  is greater  
than or equal to a predetermined reference value  $T_3$   
is carried out. If YES, the operation flow goes to  
STEP 12 and thus a warning is given. If NO, the  
operation flow returns to STEP 2 bypassing the STEP  
12.

10 As is described hereinabove, in accordance with  
the present invention, the oil degradation  
coefficients of the three major parameters (viz., oil  
temperature, engine speed and engine load) dependent  
on viscosity of oil, basicity of oil and amount of  
15 infusible matters in oil are each integrated with  
pass of time, and if at least one of the up-to-date  
integrated values exceeds a corresponding reference  
value (viz., No Good line), a warning is issued  
indicating a need of oil change.

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## WHAT IS CLAIMED IS:

1. An oil degradation warning system comprising:  
first means for detecting a plurality of parameters which are closely related to degradation factors of the engine oil;  
second means for processing said parameters to provide oil degradation coefficients of the parameters in each factor and integrating the oil degradation coefficients in each factor with passage of time;  
third means for issuing an instruction signal when at least one of the integrated values of the oil degradation coefficients exceeds a corresponding reference value; and  
fourth means for giving a warning when said instruction signal is applied thereto.
2. An oil degradation warning system as claimed in Claim 1, in which said first means comprises an oil temperature sensor which senses the temperature of the engine oil, an engine speed sensor which senses the rotation speed of the engine, and an engine load sensor which senses a load applied to the engine.
3. An oil degradation warning system as claimed in Claim 2, in which the oil degradation parameters are the viscosity of oil, the basicity of oil and the amount of infusible matters in oil.
4. An oil degradation warning system as claimed in Claim 3, further comprising fifth means which resets the integrated values of the oil degradation coefficients to zero when oil change is practically carried out.

5. An oil degradation warning system as claimed in Claim 4, further comprising sixth means which judges whether or not a predetermined time passes after said fifth means completes its work as to resetting the integrated values of the degradation coefficients.

6. An oil degradation warning system as claimed in Claim 5, further comprising seventh means which initializes a memory when an ignition switch of the associated engine is turned on.

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FIG. 1

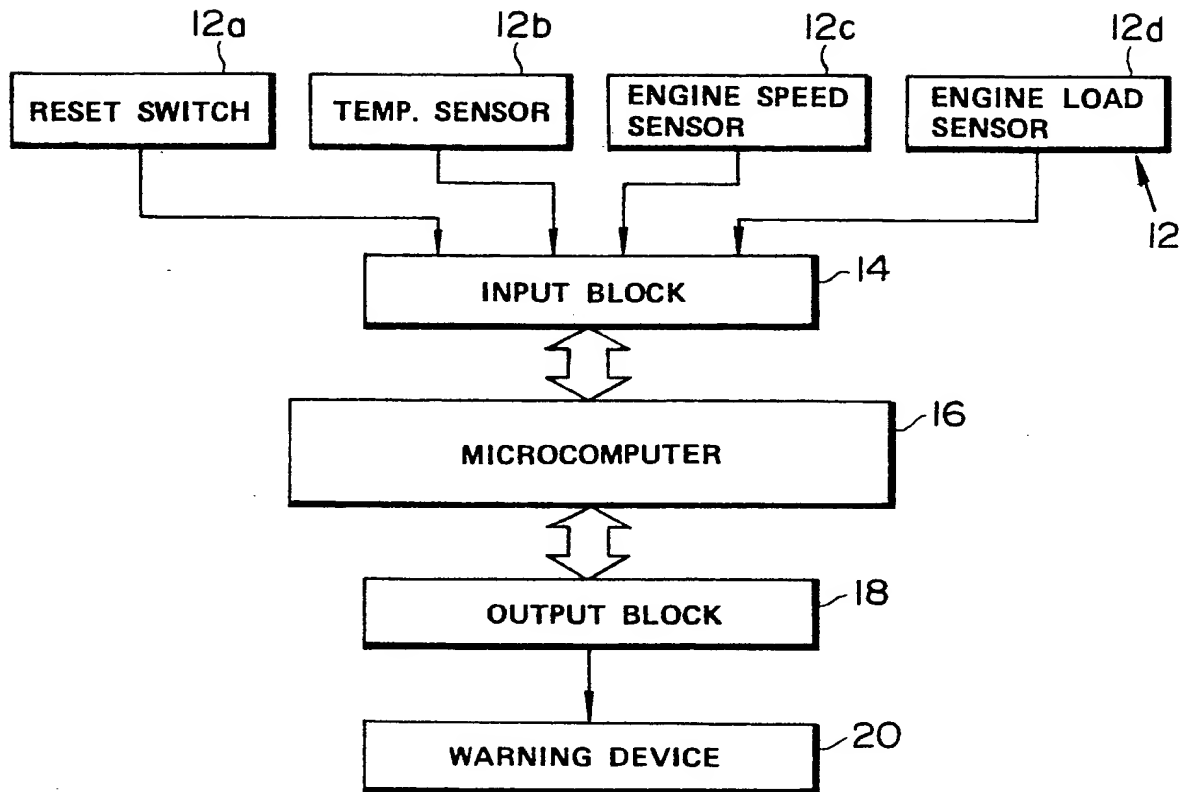
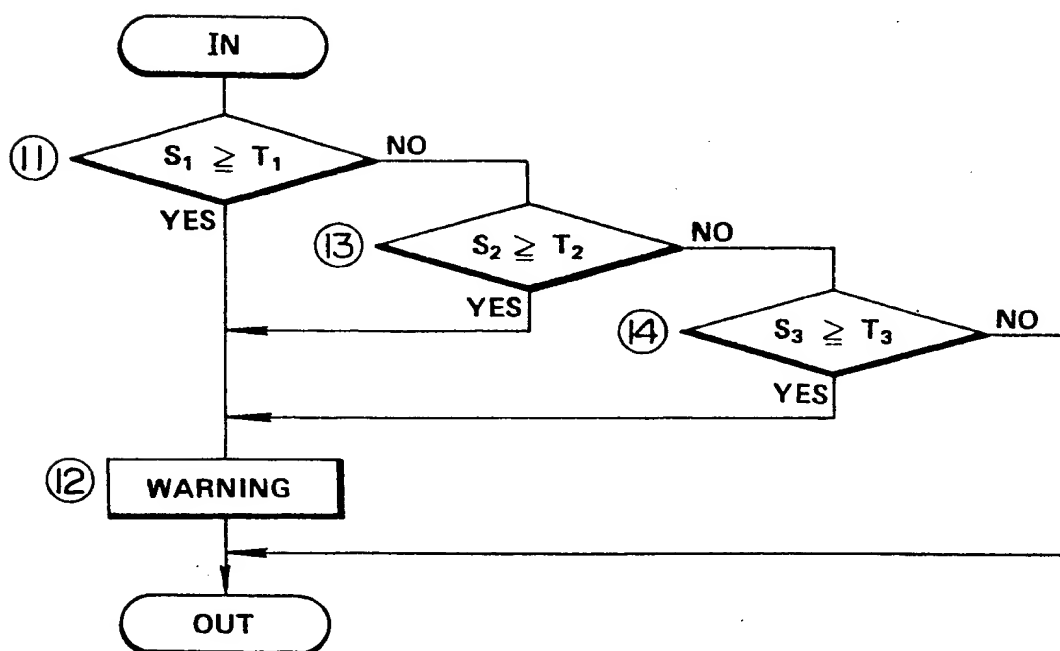
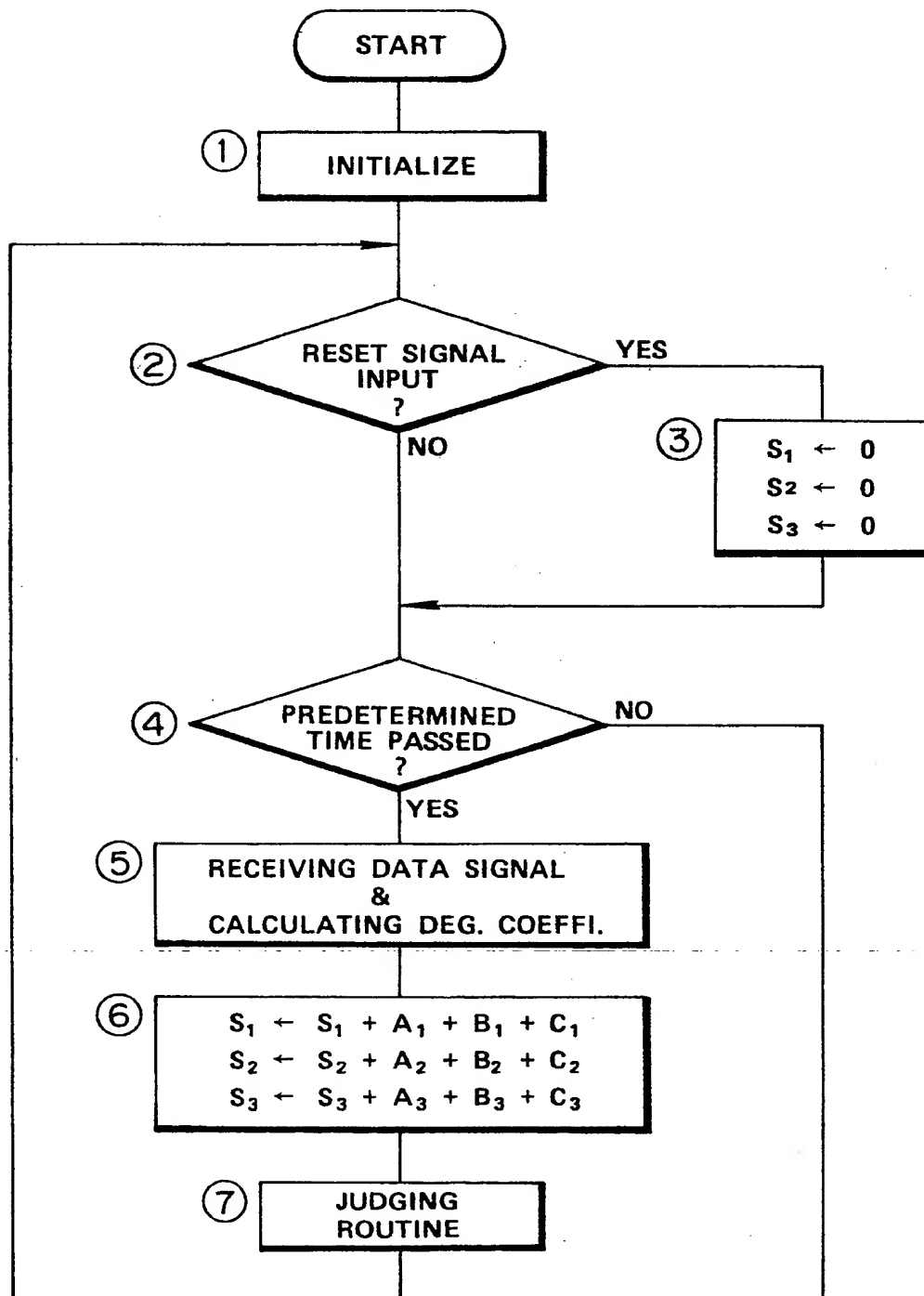


FIG. 3



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FIG.2



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FIG.4A

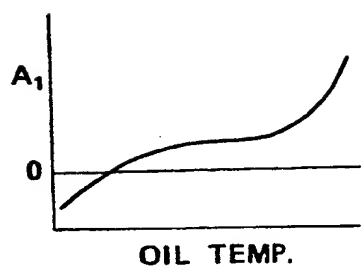


FIG.4B

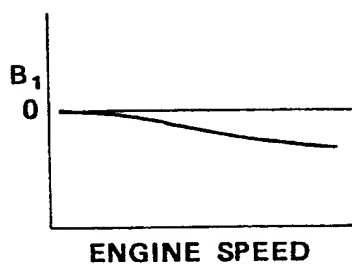


FIG.4C

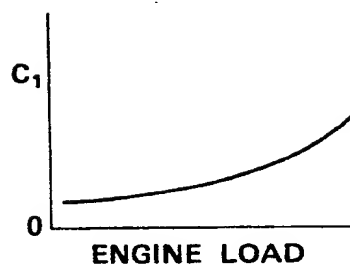


FIG.5A

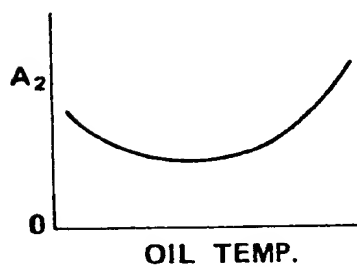


FIG.5B

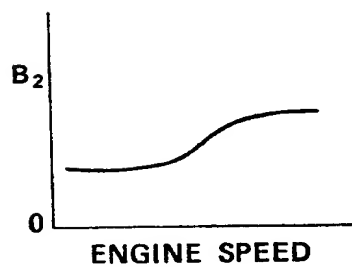


FIG.5C

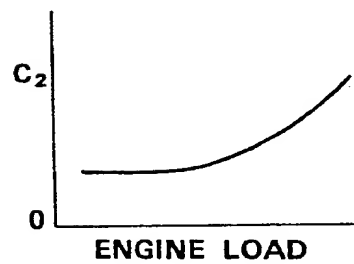


FIG.6A

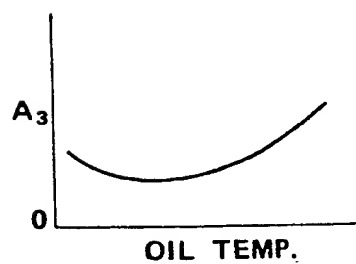


FIG.6B

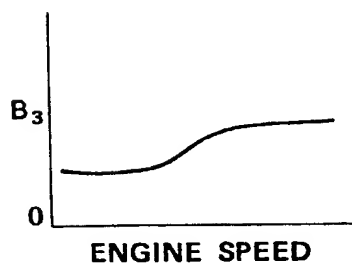
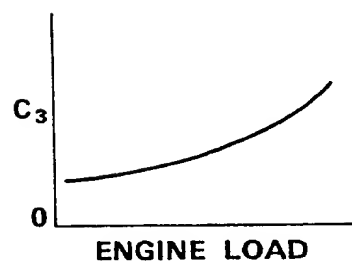


FIG.6C





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# EUROPEAN SEARCH REPORT

0174601

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 85111187.2
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	DE - A1 - 3 228 195 (NISSAN MOTOR CO., LTD.)	1	F 01 M 11/10
A	* Totality; especially fig. 5,6 *	2-4	F 16 N 29/04
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A	FR - A1 - 2 524 935 (ESSO SOCIETE ANONYME FRANCAISE)	1,2	
	* Totality *		
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A	US - A - 4 306 525 (FAXVOG)	1	
	* Totality; especially numerals 30,36,48,56,60 *		
	--		
A	DE - B2 - 1 904 879 (LOWE)	1	
	* Totality *		
	--		
A	GB - A - 1 314 458 (SMITH)	1	
	* Totality *		
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
VIENNA		18-12-1985	PIPPAN
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